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TI **Copper** alloy **foil** with good strength and electric conductivity
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AB A foil is from a Cu alloy contg. 1-4.8% Ni and 0.2-1.4% Si. The inclusions in the foil have a size of .ltoreq.10 .mu.m, and the no. of inclusions with a diam. of 5-10 .mu.m is <50/mm2 in the direction parallel to the rolling direction. The foil has good strength and elec. cond. and is suitable, e.g., for flexible PCB.

PATENT ABSTRACTS OF JAPAN

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(54) COPPER ALLOY FOIL

(57)Abstract:

PROBLEM TO BE SOLVED: To produce copper alloy foil having a sufficient strength and electrical conductivity, moreover, excellent in productivity.

SOLUTION: In the alloy, 1-4.8% Ni, 0.2-1.4% Si by weight proportion are incorporated, and a ratio of Ni concn. to Si concn. is kept preferably in 2-8, moreover preferably, ≥1 kinds among Mg, Zn, Sn, Fe, Ti, Zr, Cr, Al, Mn, Ag or Be in 0.001-2% in the total amount and the balance Cu with inevitable impurities are incorporated. and a size of an inclusion is ≤10 μm, and numbers of the inclusion having 5-10 μm size are less than 50 pieces/mm2 at a rolling parallel section. The foil is useful for a printed circuit substrate and IC tape carrier.

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CLAIMS

[Claim(s)]
[Claim 1] The inclusion number of the size which 1 - 4.8% of nickel and 0.2 - 1.4% of Si are contained, and the remainder consists of Cu and its unescapable impurity at a weight rate, and the size of inclusion is 10 micrometers or less, and is 5-10 micrometers is 2 50 pieces/mm at a rolling parallel cross section. Copper alloy foil characterized by being the following.
[Claim 2] The inclusion number of the size which 1 - 4.8% of nickel and 0.2 - 1.4% of Si are contained, it adjusts so that the ratio of concentration of nickel to Si concentration may be set to 2-8, and the remainder consists of Cu and its unescapable impurity at a weight rate, and the size of inclusion is 10 micrometers or less, and is 5-10 micrometers is 2 50 pieces/mm at a rolling parallel cross section. Copper alloy foil characterized by being the following.
[Claim 3] The copper alloy foil characterized by the following. nickel and 0.2 - 1.4% of Si which are 1 - 4.8% at a weight rate. Furthermore, one or more sorts are contained 0.001 to 2% in a total amount among Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, and Be, and the remainder consists of Cu and its unescapable impurity, and the inclusion number of the size which the size of inclusion is 10 micrometers or less, and is 5-10 micrometers is a rolling parallel cross section, and it is 2 50 pieces/mm. Following.
[Claim 4] At a weight rate, in 1 - 4.8% of nickel and 0.2 - 1.4% of Si, and a row, Mg, One or more sorts are contained 0.001 to 2% in a total amount among Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be. Adjust so that the ratio of concentration of nickel to Si concentration may be set to 2-8, and the remainder consists of Cu and its unescapable impurity. And the inclusion number of the size which the size of inclusion is 10 micrometers or less, and is 5-10 micrometers is 2 50 pieces/mm at a rolling parallel cross section. Copper alloy foil characterized by being the following.
[Claim 5] The copper alloy foil which is characterized by making the thickness of 0.1mm or less with the last rolling after performing the aging treatment of 1 - 10 hours at the temperature whose material temperature is 300-700 degrees C to the middle material which performed and obtained predetermined rolling and predetermined heat treatment to the ingot and which was indicated to either of the claims 1-4.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the Cu-nickel-Si system alloy foil which regulated the size of inclusion, and the number of inclusion especially about the copper alloy foil excellent in the suitable intensity and the suitable electrical conductivity for a use of semiconductor mounting, such as an object for flexible-printed-wiring substrates, and IC tape career.
[0002]
[Description of the Prior Art] The printed-circuit board which made the organic substance the base material is divided roughly into the hard copper clad laminate (rigid) which makes a component glass epoxy and a paper phenolic group board, and the flexible copper-clad laminated circuit board (flexible) which makes a polyimide and a polyester substrate a component, and copper foil is mainly used as electric conduction material of a printed-circuit board. Copper foil is classified into an electrolytic copper foil and rolling copper foil according to the difference in the manufacture method. Among the above-mentioned printed-circuit boards, the flexible printed circuit substrate as which multilayer-board-izing of a printed wired board according to the formation of a high-density circuit more and high flexibility are required laminates copper foil in a resin substrate, and it unifies by adhesives or heating pressurization, and it is formed. As copper foil used, many rolling copper foil of a tough pitch copper or an oxygen free copper is used, and many multilayer-interconnection substrates called build-up substrate are used as an effective means of high density assembly in recent years.
[0003] Furthermore, some printed-circuit boards are used for mounting of a semiconductor chip as a tape carrier and a TAB (tape automated bonding) lead. In the field of mounting of a semiconductor chip, BGA(ball grid array)-izing and CSP(chip-size package)-ization are advanced in recent years for improvement in the packaging density. Thereby, although the number of terminals per area increases, since a terminal serves as a ** pitch, a high-density wiring substrate is simultaneously needed also for the substrate to mount. As an effective means for densification realization, the multilayer substrate is used also in the semiconductor mounting field.
[0004] On the other hand, if the thickness of a foil becomes thin in a manufacturing process, it will become difficult to roll out with the sufficient yield. Since especially the internal defect of inclusion etc. becomes the cause which produces fracture and produces a pinhole again at the time of rolling, it reduces productivity, as a result causes increase of a manufacturing cost. Therefore, a material is expected for there to be little inclusion. In recent years, a deposited type copper alloy is used on the use of which the high intensity and high conductivity like an electronic equipment copper alloy are required in many cases. An Cu-nickel-Si system copper alloy is a typical deposited type copper alloy having high intensity and high conductivity, and is put in practical use as a charge of electronic equipment material. In this alloy, in aging deposit process, when a detailed nickel2 Si deposit particle arises in a copper matrix, intensity and conductivity rise.
[0005]
[Problem(s) to be Solved by the Invention] The above-mentioned printed circuit board is used for the thing and (2) drive systems (for example, the head portion of a printer, the circuit board for a drive in a hard disk, etc.) which are used in the state where it bent at the time of (1) assembly, being fixed, and is used for that by which 10,000 crookedness or more is repeated. Since a miniaturization is required and the printed circuit board itself runs short of intensity with a pure-copper foil in connection with a miniaturization and densification of electronic equipment in recent years, problems, such as cutting or deformation, arise at the time of processing of

parts and an assembly. Moreover, since thermal resistance was remarkable and a pure copper's was low, the problem of deformation and an open circuit occurred by heating at the time of laminating copper foil in a resin substrate, and it had the fault that reliability fell.
[0006] in the field of mounting of a semiconductor chip, detailed-ization of the circuit rule of the chip carried is progressing, and "0.1 - 0.2-micrometer rule" is developed In order in the case of 0.1-0.2-micrometer rule to set to about 40 micrometers the pitch of the gold or the aluminum bump who attaches to a chip rear face and to join the bump of 40-micrometer pitch, it is necessary to set the wiring pitch of a substrate to 15 micrometers or less. In order to set the pitch of wiring to 15 micrometers or less, it is necessary to set to 14 micrometers or less board thickness of the copper foil used for a substrate. This is because etching and assembly processing cannot be performed, if board thickness of copper foil is not made below into a pitch. However, in conventional rolling copper foil, if board thickness is set to 14 micrometers or less, problems, such as cutting or deformation, will arise at the time of a strong insufficient shell and IRB (inner lead bonding). Therefore, sufficient intensity which can cope with the above-mentioned request, and material with still more sufficient electrical conductivity are called for.
[0007] Although it is one of the effective meanses to use the copper alloy which added a certain kind of alloying element to the above-mentioned demand, only by using a copper alloy, not necessarily sufficient intensity is not obtained and, in addition, the problem of the fall of the electrical conductivity which is other required properties of a substrate produces it by addition of an element. Although intensity and conductivity rise in the Cu-nickel-Si system alloy mentioned above when a detailed nickel2 Si deposit particle arises in a copper matrix Since the big and rough crystallization object which is not contributed to improvement in intensity tends to remain in a matrix on the other hand, and the activity of Si is high and it is easy to generate an oxide etc., the result of being easy to become the organization which these comparatively big particles distributed in the matrix is to be induced. If these big and rough particles exist, since it will become the cause which fracture and a pinhole produce at the time of rolling in putting an Cu-nickel-Si system alloy in practical use as a copper alloy foil material, productivity is reduced, as a result increase of a manufacturing cost is caused. It is making into the technical problem for this invention to offer the Cu-nickel-Si system copper alloy foil which the technical-problem solution mentioned above was benefited, has sufficient intensity and sufficient electrical conductivity, and was further excellent also in productivity.
[0008]
[Means for Solving the Problem] Then, when research of the copper alloy foil which is suitable as a metallic foil was repeated, after performing the quality governing of an Cu-nickel-Si system alloy, this invention persons While making Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, and Be contain if needed It found out that a material suitable as an alloy foil could be offered by controlling and selecting manufacture conditions and controlling a distribution of inclusion, such as a sludge in a matrix, a crystallization object, and an oxide. this invention is completed based on the above-mentioned knowledge, and 1 - 4.8% of nickel and 0.2 - 1.4% of Si are contained in a copper alloy. preferably It is made for the ratio of nickel concentration to Si concentration to be set to 2-8. still more preferably One or more sorts are contained 0.001 to 2% in a total amount among Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, and Be. The remainder consists of Cu and its unescapable impurity, and the size of inclusion is 10 micrometers or less. And the number of inclusion with a size of 5-10 micrometers is 2 50 pieces/mm at a rolling parallel cross section. The intensity and the electrical conductivity sufficient as the object for printed-circuit boards or an object for IC tape careers which are characterized by being the following are made to have, and a copper alloy foil also with still better productivity is offered.
[0009] In this invention with a term "inclusion" The cooling process after the solidification process at the time of casting (i.e., the solidification back), The sludge produced at a deposit reaction in the matrix of solid phase at the time of the cooling process after hot rolling, and aging annealing, An oxide, a sulfide, etc. which are an impurity which produces according to the segregation of the solidification process at the time of casting, and is generally produced by the reaction within a big and rough crystallization object and the molten metal at the time of the dissolution are used as what includes the particle observed by microscope observation of this alloy in a matrix. "The size of inclusion" says the minimum diameter of circle which contains the inclusion for inclusion under microscope observation. "The number of inclusion" is the inclusion number per [which actually counted many rolling parallel cross sections of material in the part by microscope observation] unit square mm.

[0010]
[Embodiments of the Invention] Next, the reason which limited the inclusion size to the component composition row of a copper alloy like the above in this invention is explained with the operation.
[0011] (nickel and Si) There is an operation which raises alloy intensity when each dissolves in an alloy, and nickel and Si also raise electrical conductivity remarkably while nickel and Si form the sludge of nickel2 Si composition mutually and make the intensity of an alloy increase remarkably by performing a suitable aging treatment. However, the intensity which it considers as a request even if nickel content is accompanied by compound addition of other components, when under 1% (percentage is weight % unless it mentions specially), or Si content is less than 0.2% is not obtained. Moreover, when nickel content is [4.8% or more or Si content] 1.4% or more, the electrical conductivity considered as a request is not acquired, but a still bigger and rougher nickel-Si particle generates in a host phase. Consequently, the fall of productivity will be caused by the fracture at the time of rolling, pinhole generating, etc. Therefore, the content of 1 - 4.8% and Si was determined for the content of nickel as 0.2 - 1.4%. Moreover, in order to raise the electrical conductivity after an aging treatment more, it is desirable to bring the ratio of concentration of nickel and Si in an alloy close to the ratio of concentration of a nickel2 Si sludge. The ratios (nickel concentration / Si concentration) of nickel concentration to Si concentration for acquiring good electrical conductivity are 2-8, and 4 is the most desirable.
[0012] (Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be) Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be has the operation which improves the intensity of an nickel-Si system copper alloy, and thermal resistance. Moreover, there is an effect of improving the thermal resistance of the soldered joint section in Zn, in these, and there is an effect which makes an organization detailed in Fe. Furthermore, Mg, Ti, Zr, aluminum, and Mn also have the effect of improving hot rolling nature. this effect is for mitigating the segregation of the sulfur to the ingot grain boundary which forms sulfur and a compound since compatibility with sulfur has the strong element of these, and causes a hot rolling crack The above-mentioned effect is not acquired with the content of Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be being less than 0.001% in a total amount, but if the total content exceeds 2% on the other hand, electrical conductivity will fall remarkably. Then, these contents are determined as 0.001 - 2% in a total amount.
[0013] (Inclusion) By this alloy system, the particle of inclusion may exist in a matrix. Although the inclusion for obtaining intensity required for this alloy is small, not contributing the big and rough inclusion exceeding 0.5 micrometers to intensity and especially a big and rough thing is set like a roll turner, becomes fracture and the cause of a pinhole, and reduces productivity remarkably. It is the inclusion number with a size [in / a rolling parallel cross section / in order not to cause such fault, the upper limit of the size of this big and rough inclusion is set to 10 micrometers, and] of 5-10 micrometers 50 pieces/mm 2 What is necessary is just to consider as the following.
[0014] Next, the manufacturing process for obtaining this alloy is explained. In order to acquire desired intensity and desired electrical conductivity, the temper state of a material needs to be in an aging-treatment state. Although it is required in order that this aging treatment may raise intensity and electrical conductivity, it is necessary to make aging-treatment temperature into 300-700 degrees C. It is for an aging treatment to take time at less than 300 degrees C, for nickel and Si to dissolve, if it is not economical and exceeds 700 degrees C, and for improvement in the intensity by aging and electrical conductivity not to arise. Moreover, although desired board thickness is made with cold rolling at a degree, as for the thickness of the foil after cold rolling, it is desirable to carry out to below 100 micrometers (0.1mm), and the desirable thickness of the rolling copper alloy foil supposing the anticipated-use gestalt is 0.035mm, 0.07mm, 0.018mm, or 0.010mm.
[0015]
[Example] Hereafter, an example and the example of comparison explain this invention in more detail.
(An example and example of comparison) The copper alloy of the various component composition shown in Table 1 with a RF fusion furnace was ingoted, and it cast to the ingot with a thickness of 20mm. Next, after hot-rolling this ingot to 8mm in thickness at 800-950-degree-C temperature and performing facing for surface descaling, it considered as the board with a thickness of 2mm with cold rolling. Then, after performing solution treatment for 10 minutes at the temperature of 800-900 degrees C, it cold-rolled to 0.5mm. And further, after performing aging of 5 hours at the temperature of 400-600 degrees C, it considered as the foil with a thickness of 0.018mm with cold rolling.

[0016] Thus, many properties were evaluated per [which was obtained] each alloy foil. In addition, in front Naka, the tough pitch copper was conventionally written together as an alloy. About "intensity", tensile strength was measured in the tension tester. Conductivity (%IACS) showed "electrical conductivity." "Heat-resistant" evaluation asked for the temperature which becomes in the middle of the intensity when heating for 30 minutes at various temperature, and softening enough with the intensity before tensile strength heating as a softening temperature. The inclusion number is the inclusion number with a size [per / which observed the rolling parallel cross section of material under the microscope, and were actually counted in the part / unit square mm] of 5-10 micrometers. The foil with the thickness of 0.018 micrometers, a width of face [of 450mm], and a length of 5000m was produced, and evaluation of productivity was also performed. The inner fracture generating situation and the pinhole generating situation in a product stage estimated "productivity" like the roll turner. About "fracture", the case where fracture did not occur was made as O, and the case where it fractured was made into x. About the "pinhole", the generating number of a pinhole with a diameter [per 1000m] of 0.5mm or more was measured.

[0017]

[Table 1]

表 1 本発明合金および比較例

		成分（重量%）			引張強さ N/mm²	導電率 %IACS	軟化温度 ℃	介在物数 個/mm²	破断の有無	ピンホール発生個数 個/1000m
		Ni	Si	副成分						
本発明合金	1	2.60	0.65	—	802	51	580	11	○	7
	2	2.83	0.67	0.15 Mg	818	49	580	8	○	2
	3	1.63	0.40	0.42 Zn	722	54	560	2	○	2
	4	2.54	0.66	0.021 Al	746	50	570	14	○	8
	5	3.66	0.88	0.21 Zr	854	43	590	32	○	8
	6	2.64	0.36	0.31 Cr	770	44	570	4	○	1
	7	2.32	0.86	0.59 Fe	795	40	570	19	○	4
	8	2.48	0.56	0.03 Ag 0.62 Zn	792	47	570	4	○	3
比較合金	1	0.90	0.84	—	581	33	530	61	×	18
	2	0.48	0.26	—	461	65	530	1	○	1
	3	2.59	2.11	0.64 Cr	802	26	580	102	×	29
	4	2.60	0.67	1.26 Mg 1.84 Sn	812	24	590	39	○	17
従来材		タフピッチ銅			380	97	140	—	○	2

[0018] As shown in Table 1, this invention alloy foil has intensity, the outstanding conductivity, and outstanding thermal resistance. Fracture is not generated. There is little generating number of a pinhole and it is eight pieces at the maximum. On the other hand, it is a comparison alloy. No.1- No.4 are a comparison alloy as compared with this invention alloy, although composition of this invention alloy and a part differs. As for No.1, intensity and conductivity are inferior to a low sake in nickel. Comparison alloy As for No.2, intensity and conductivity are inferior to a low sake in nickel and Si. Comparison alloy Since No.3 have high Si, conductivity is inferior in them. Comparison alloy Since No.4 contain an accessory constituent exceeding the density range of this invention, conductivity is inferior in them. moreover, example of comparison No. -- 1 and 3 are the examples which fracture generated in the manufacturing process since there was much inclusion number, and the number of a pinhole increased

[0019]

[Effect of the Invention] As explained above, according to this invention, it has intensity, the outstanding

electrical conductivity, and outstanding thermal resistance, the copper alloy foil which was further excellent also in productivity is obtained, and this copper alloy foil is suitable as a reliable copper alloy foil material in the use of semiconductor mounting fields, such as an object for printed-circuit boards, and IC tape career.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the Cu-nickel-Si system alloy foil which regulated the size of inclusion, and the number of inclusion especially about the copper alloy foil excellent in the suitable intensity and the suitable electrical conductivity for a use of semiconductor mounting, such as an object for flexible-printed-wiring substrates, and IC tape career.

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PRIOR ART

[Description of the Prior Art] The printed-circuit board which made the organic substance the base material is divided roughly into the hard copper clad laminate (rigid) which makes a component glass epoxy and a paper phenolic group board, and the flexible copper-clad laminated circuit board (flexible) which makes a polyimide and a polyester substrate a component, and copper foil is mainly used as electric conduction material of a printed-circuit board. Copper foil is classified into an electrolytic copper foil and rolling copper foil according to the difference in the manufacture method. Among the above-mentioned printed-circuit boards, the flexible printed circuit substrate as which multilayer-board-izing of a printed wired board according to the formation of a high-density circuit more and high flexibility are required laminates copper foil in a resin substrate, and it unifies by adhesives or heating pressurization, and it is formed. As copper foil used, many rolling copper foil of a tough pitch copper or an oxygen free copper is used, and many multilayer-interconnection substrates called build-up substrate are used as an effective means of high density assembly in recent years.
[0003] Furthermore, some printed-circuit boards are used for mounting of a semiconductor chip as a tape carrier and a TAB (tape automated bonding) lead. In the field of mounting of a semiconductor chip, BGA(ball grid array)-izing and CSP(chip-size package)-ization are advanced in recent years for improvement in the packaging density. Thereby, although the number of terminals per area increases, since a terminal serves as a ** pitch, a high-density wiring substrate is simultaneously needed also for the substrate to mount. As an effective means for densification realization, the multilayer substrate is used also in the semiconductor mounting field.
[0004] On the other hand, if the thickness of a foil becomes thin in a manufacturing process, it will become difficult to roll out with the sufficient yield. Since especially the internal defect of inclusion etc. becomes the cause which produces fracture and produces a pinhole again at the time of rolling, it reduces productivity, as a result causes increase of a manufacturing cost. Therefore, a material is expected for there to be little inclusion. In recent years, a deposited type copper alloy is used on the use of which the high intensity and high conductivity like an electronic equipment copper alloy are required in many cases. An Cu-nickel-Si system copper alloy is a typical deposited type copper alloy having high intensity and high conductivity, and is put in practical use as a charge of electronic equipment material. In this alloy, in aging deposit process, when a detailed nickel2 Si deposit particle arises in a copper matrix, intensity and conductivity rise.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, it has intensity, the outstanding electrical conductivity, and outstanding thermal resistance, the copper alloy foil which was further excellent also in productivity is obtained, and this copper alloy foil is suitable as a reliable copper alloy foil material in the use of semiconductor mounting fields, such as an object for printed-circuit boards, and IC tape career.

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[0006] in the field of mounting of a semiconductor chip, detailed-ization of the circuit rule of the chip carried is progressing, and "0.1 - 0.2-micrometer rule" is developed In order in the case of 0.1-0.2-micrometer rule to set to about 40 micrometers the pitch of the gold or the aluminum bump who attaches to a chip rear face and to join the bump of 40-micrometer pitch, it is necessary to set the wiring pitch of a substrate to 15 micrometers or less. In order to set the pitch of wiring to 15 micrometers or less, it is necessary to set to 14 micrometers or less board thickness of the copper foil used for a substrate. This is because etching and assembly processing cannot be performed, if board thickness of copper foil is not made below into a pitch. However, in conventional rolling copper foil, if board thickness is set to 14 micrometers or less, problems, such as cutting or deformation, will arise at the time of a strong insufficient shell and IRB (inner lead bonding). Therefore, sufficient intensity which can cope with the above-mentioned request, and material with still more sufficient electrical conductivity are called for.

[0007] Although it is one of the effective meanses to use the copper alloy which added a certain kind of alloying element to the above-mentioned demand, only by using a copper alloy, not necessarily sufficient intensity is not obtained and, in addition, the problem of the fall of the electrical conductivity which is other required properties of a substrate produces it by addition of an element. Although intensity and conductivity rise in the Cu-nickel-Si system alloy mentioned above when a detailed nickel2 Si deposit particle arises in a copper matrix Since the big and rough crystallization object which is not contributed to improvement in intensity tends to remain in a matrix on the other hand, and the activity of Si is high and it is easy to generate an oxide etc., the result of being easy to become the organization which these comparatively big particles distributed in the matrix is to be induced. If these big and rough particles exist, since it will become the cause which fracture and a pinhole produce at the time of rolling in putting an Cu-nickel-Si system alloy in practical use as a copper alloy foil material, productivity is reduced, as a result increase of a manufacturing cost is caused. It is making into the technical problem for this invention to offer the Cu-nickel-Si system copper alloy foil which the technical-problem solution mentioned above was benefited, has sufficient intensity and sufficient electrical conductivity, and was further excellent also in productivity.

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MEANS

[Means for Solving the Problem] Then, when research of the copper alloy foil which is suitable as a metallic foil was repeated, after performing the quality governing of an Cu-nickel-Si system alloy, this invention persons While making Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, and Be contain if needed It found out that a material suitable as an alloy foil could be offered by controlling and selecting manufacture conditions and controlling a distribution of inclusion, such as a sludge in a matrix, a crystallization object, and an oxide. this invention is completed based on the above-mentioned knowledge, and 1 - 4.8% of nickel and 0.2 - 1.4% of Si are contained in a copper alloy. preferably It is made for the ratio of nickel concentration to Si concentration to be set to 2-8. still more preferably One or more sorts are contained 0.001 to 2% in a total amount among Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, and Be. The remainder consists of Cu and its unescapable impurity, and the size of inclusion is 10 micrometers or less. And the number of inclusion with a size of 5-10 micrometers is 2 50 pieces/mm at a rolling parallel cross section. The intensity and the electrical conductivity sufficient as the object for printed-circuit boards or an object for IC tape careers which are characterized by being the following are made to have, and a copper alloy foil also with still better productivity is offered.
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[0010]
[Embodiments of the Invention] Next, the reason which limited the inclusion size to the component composition row of a copper alloy like the above in this invention is explained with the operation.
[0011] (nickel and Si) There is an operation which raises alloy intensity when each dissolves in an alloy, and nickel and Si also raise electrical conductivity remarkably while nickel and Si form the sludge of nickel2 Si composition mutually and make the intensity of an alloy increase remarkably by performing a suitable aging treatment. However, the intensity which it considers as a request even if nickel content is accompanied by compound addition of other components, when under 1% (percentage is weight % unless it mentions specially), or Si content is less than 0.2% is not obtained. Moreover, when nickel content is [4.8% or more or Si content] 1.4% or more, the electrical conductivity considered as a request is not acquired, but a still bigger and rougher nickel-Si particle generates in a host phase. Consequently, the fall of productivity will be caused by the fracture at the time of rolling, pinhole generating, etc. Therefore, the content of 1 - 4.8% and Si was determined for the content of nickel as 0.2 - 1.4%. Moreover, in order to raise the electrical conductivity after an aging treatment more, it is desirable to bring the ratio of concentration of nickel and Si in an alloy close to the ratio of concentration of a nickel2 Si sludge. The ratios (nickel concentration / Si concentration) of nickel concentration to Si concentration for acquiring good electrical conductivity are 2-8, and 4 is the most desirable.
[0012] (Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be) Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be has the operation which improves the intensity of an nickel-Si system copper alloy, and thermal resistance.

Moreover, there is an effect of improving the thermal resistance of the soldered joint section in Zn, in these, and there is an effect which makes an organization detailed in Fe. Furthermore, Mg, Ti, Zr, aluminum, and Mn also have the effect of improving hot rolling nature. this effect is for mitigating the segregation of the sulfur to the ingot grain boundary which forms sulfur and a compound since compatibility with sulfur has the strong element of these, and causes a hot rolling crack The above-mentioned effect is not acquired with the content of Mg, Zn, Sn, Fe, Ti, Zr, Cr, aluminum, Mn, Ag, or Be being less than 0.001% in a total amount, but if the total content exceeds 2% on the other hand, electrical conductivity will fall remarkably. Then, these contents are determined as 0.001 - 2% in a total amount.

[0013] (Inclusion) By this alloy system, the particle of inclusion may exist in a matrix. Although the inclusion for obtaining intensity required for this alloy is small, not contributing the big and rough inclusion exceeding 0.5 micrometers to intensity and especially a big and rough thing is set like a roll turner, becomes fracture and the cause of a pinhole, and reduces productivity remarkably. It is the inclusion number with a size [in / a rolling parallel cross section / in order not to cause such fault, the upper limit of the size of this big and rough inclusion is set to 10 micrometers, and] of 5-10 micrometers 50 pieces/mm 2 What is necessary is just to consider as the following.

[0014] Next, the manufacturing process for obtaining this alloy is explained. In order to acquire desired intensity and desired electrical conductivity, the temper state of a material needs to be in an aging-treatment state. Although it is required in order that this aging treatment may raise intensity and electrical conductivity, it is necessary to make aging-treatment temperature into 300-700 degrees C. It is for an aging treatment to take time at less than 300 degrees C, for nickel and Si to dissolve, if it is not economical and exceeds 700 degrees C, and for improvement in the intensity by aging and electrical conductivity not to arise. Moreover, although desired board thickness is made with cold rolling at a degree, as for the thickness of the foil after cold rolling, it is desirable to carry out to below 100 micrometers (0.1mm), and the desirable thickness of the rolling copper alloy foil supposing the anticipated-use form is 0.035mm, 0.07mm, 0.018mm, or 0.010mm.

[0015]

[Translation done.]

* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EXAMPLE

[Example] Hereafter, an example and the example of comparison explain this invention in more detail.
(An example and example of comparison) The copper alloy of the various component composition shown in Table 1 with a RF fusion furnace was ingoted, and it cast to the ingot with a thickness of 20mm. Next, after hot-rolling this ingot to 8mm in thickness at 800-950-degree-C temperature and performing facing for surface descaling, it considered as the board with a thickness of 2mm with cold rolling. Then, after performing solution treatment for 10 minutes at the temperature of 800-900 degrees C, it cold-rolled to 0.5mm. And further, after performing aging of 5 hours at the temperature of 400-600 degrees C, it considered as the foil with a thickness of 0.018mm with cold rolling.
[0016] Thus, many properties were evaluated per [which was obtained] each alloy foil. In addition, in front Naka, the tough pitch copper was conventionally written together as an alloy. About "intensity", tensile strength was measured in the tension tester. Conductivity (%IACS) showed "electrical conductivity." "Heat-resistant" evaluation asked for the temperature which becomes in the middle of the intensity when heating for 30 minutes at various temperature, and softening enough with the intensity before tensile strength heating as a softening temperature. The inclusion number is the inclusion number with a size [per / which observed the rolling parallel cross section of material under the microscope, and were actually counted in the part / unit square mm] of 5-10 micrometers. The foil with the thickness of 0.018 micrometers, a width of face [of 450mm], and a length of 5000m was produced, and evaluation of productivity was also performed. The inner fracture generating situation and the pinhole generating situation in a product stage estimated "productivity" like the roll turner. About "fracture", the case where fracture did not occur was made as O, and the case where it fractured was made into x. About the "pinhole", the generating number of a pinhole with a diameter [per 1000m] of 0.5mm or more was measured.
[0017]
[Table 1]

表1　本発明合金および比較例

		成分（重量%）			引張強さ N/mm²	導電率 %IACS	軟化温度 ℃	介在物数 個/mm²	破断の有無	ピンホール発生個数 個/1000m
		Ni	Si	副成分						
本発明合金	1	2.60	0.65	−	802	51	580	11	○	7
	2	2.83	0.67	0.15 Mg	818	49	580	8	○	2
	3	1.63	0.40	0.42 Zn	722	54	560	2	○	2
	4	2.54	0.66	0.021 Al	746	50	570	14	○	8
	5	3.66	0.88	0.21 Zr	854	43	590	32	○	8
	6	2.64	0.36	0.31 Cr	770	44	570	4	○	1
	7	2.32	0.86	0.59 Fe	795	40	570	19	○	4
	8	2.48	0.56	0.03 Ag 0.62 Zn	792	47	570	4	○	3
比較合金	1	0.90	0.84	−	581	33	530	61	×	18
	2	0.48	0.26	−	461	65	530	1	○	1
	3	2.59	2.11	0.64 Cr	802	26	580	102	×	29
	4	2.60	0.67	1.26 Mg 1.84 Sn	812	24	590	39	○	17
従来材		タフピッチ銅			380	97	140	−	○	2

[0018] As shown in Table 1, this invention alloy foil has intensity, the outstanding conductivity, and outstanding thermal resistance. Fracture is not generated. There is little generating number of a pinhole and it is eight pieces at the maximum. On the other hand, it is a comparison alloy. No.1- No.4 are a comparison alloy as compared with this invention alloy, although composition of this invention alloy and a part differs. As for No.1, intensity and conductivity are inferior to a low sake in nickel. Comparison alloy Since nickel and Si are low, as for No.2, intensity and conductivity are inferior in them. Comparison alloy Since No.3 have high Si, conductivity is inferior in them. Comparison alloy Since No.4 contain an accessory constituent exceeding the density range of this invention, conductivity is inferior in them. moreover, example of comparison No. -- 1 and 3 are the examples which fracture generated in the manufacturing process since there was much inclusion number, and the number of a pinhole increased

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[Translation done.]